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STUDENT ESSAY

WEATHER SUPPORT TO THE MODERN ARMY

BY

LIEUTENANT COLONEL LEANDER PAGE III

19 APRIL 1982

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PENNSYLVANIA

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The study describes the current support provided to the US Army by the USAF Air Weather Service (AWS) and identify problems of interservice support. In the conclusion it is brought to light how little the US Army leadership knows about the impact of modern systems upon the weapons systems available.

Final recommendations are made to increase AWS support the needs of Army 86.

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US ARMY WAR COLLEGE

INDIVIDUAL RESEARCH BASED ESSAY

WEATHER SUPPORT TO THE MODERN ARMY

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LIEUTENANT COLONEL LEANDER PAGE III

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ABSTRACT

Force Modernization and Army 86 organizational changes expand the area and scope of military operations which makes the impact of weather greater than at any other time. This study builds on the historical roots of the problems related to long range weather forecasting as shown during the Normandy Invasion and related to the tactical aspects of the battlefield as shown during the Battle of the Bulge. The study describes current support provided to the Army by the USAF Air Weather Service (AWS) and centers on the problems of interservice support. The goal of the study is to investigate the problems that electro-optical systems and precision guided munitions introduced to the Army by Force Modernization and used by the Air Force to fight the AirLand Battle will encounter because of weather. The conclusion of the study is that Army leaders know little about weather impact on modern systems; the Army does not test systems like Laser Target Designators, Copperhead, and Bellfire while in the initial Research, Development, Test and Evaluation phase nor future systems like the Multiple Launch Rocket System (MOD III) and Assault Breaker for the impact of weather and visibility that could virtually eliminate their use in adverse weather; the Army is doing very little to train its Military Intelligence and Combat Arms leaders to understand the details of weather and what it can do to the systems brought on by Force Modernization. Finally several recommendations are made to increase Air Weather Service support, to enhance the

knowledge of Army leadership about the impact of weather, and to reorganize weather support in both services into a centrally controlled system that will meet the needs of Army 86.

ASSUMPTIONS AND LIMITATIONS

In this study I have concentrated on AWS support to Army ground forces in the field operating modern weapon systems and employing Army 86 concepts. I have assumed that current support to garrisons and to aviation are satisfactory and have tried to focus on weather support concepts in a wartime scenario. Although I have mentioned some inadequacies in Artillery Metrorology and research areas, I have not looked at the significant amount of direct weather support that the Army provides itself. As I looked at AWS support I wanted to know what the Army was doing with weather in making decisions about how to fight rather than the details of AWS procedures in producing the information.

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CHAPTER I

THE HISTORICAL PERSPECTIVE

Introduction

As new combat doctrine is developed in the U.S. Army Training and Doctrine Command (TRADOC) to match the equipment brought on by Force Modernization and Army 86 organizational changes, how to support these emerging systems is a central issue. Force Modernization expands the area and scope of military operations and the impact of weather increases with it for many new systems and tactics! Weather support traditionally has been a key factor in planning and operations. New target acquisition systems and precision guided munitions (PGM) add increased importance to just employing new weapons in new ways. Ideally with no fiscal constraints true all weather capabilities might be designed into new systems. Realities however, dictate that as we prepare to fight the AirLand Battle with Army 86, weather is still a key factor in Army planning, operation and doctrine.

World War II was the first war where forecasts reached a performance level where it could play a significant role in overall strategy and battlefield tactics. I have chosen a few examples from that conflict to highlight the impact of weather on Army operations.

In a second theme used in the paper I have tried to look at U.S. Air Force weather support to the Army today to determine what implica-

tions Force Modernization will have on the way Air Weather Service supports combat arms elements. I have centered my analysis on whether the weather support is adequate today and will it be adequate for Army 86.

Army 86 doctrine will continue to emerge in the near future. Faced by the well known Soviet superiority in numbers and new found superiority in quality of equipment, the Army with its new systems will concentrate on engaging the first echelon, and coordinating the Air Force effort to engaged the second echelon. This will call for an unprecedented integration of Army and Air Force coordination efforts to command and control the air attack in the AirLand Battle. Air Force battlefield air interdiction (BAI) will remain the primary means to fight deep, and Air Force systems will be the primary means to see deep until modern corps and Army level systems are acquired. The impact of weather on the ability of the Air Force to see and strike deep are of vital importance to Army leaders directing the AirLand Battle, just as it is on their own modern systems. It must be with a new level of importance that Army leadership assesses weather in the intelligence chain between the enemy and terrain.

General History

Ever since man has organized armies, he has known the importance of weather to cover his attack, to enable him to manuever, and to cover his retreat.[1] To know in advance what the weather will be is a great advantage that only became available in recent history. Sun Tzu emphasized the use of weather in his concept of manuever warfare.[2] Clausewitz reaffirmed this thesis but placed greatest emphasis on visibility.[3]

Despite several centuries of sailing the oceans relatively little

was known about weather until the 1800's. Invention of the electric telegraph and a perceived need to correlate weather and health prompted the first Army weather observations by Army surgeons in 1818.[4] Real understanding of weather still did not exist and smoke from battles were even considered to be cloud seeding devices for prolonged rains that often followed several Civil War battles.[5] At the Battle of Gettysburg rain did indeed follow that three day battle. Lee marched all afternoon and night from the battlefield with heavy trains of ammunition in wagons slowed by pouring rain that swelled the Potomac to overflowing and destroy the pontoon bridges Lee had intended to use.[6] By the time Meade finally did pursue Lee, he had repaired the bridges and escaped across the Potomac.

Congress charged the Army to provide storm warning service to storm ravaged commercial ships on the Great Lakes and the Signal Corps started the meteorology section in 1870.[7] Advances in artillery increased the need as did aviation and gas warfare by the time of the Great War.

A quick survey shows critical battles hinged on weather in American History and the History of the World. Washington crossed the Delaware during the cover of a snowstorm, and Cornwallis surrendered at Yorktown after a storm aborted his attempt to evacuate his troops.[8] Napoleon's defeat at Waterloo may be attributed to torrential rainstorms which prevented him from pursuing Wellington on June 17, 1815.[9] From Ghenghis Khan to the Korean War frozen rivers have played an important part in planning. In World War I, mud was a tremendous factor. History is filled with the critical importance of weather.

However, it was not until World War II where weather forecasts played a key role in planning the war. The invasion of Poland, the

cracking of the Mareth Line in Tunisia by the British Eighth Army, the Japanese withdrawal from Kiska, the escape of the German battle cruisers Gneisenau and Sharnhorst, the invasion of Leyte, the Battle of Stalingrad, the crossing of the Roer all depended on critical weather forecasts.[10] An Associate Press correspondent in summarizing the planning of the invasion of Okinawa referred to the importance of weather in this way, "It ranks with guns and ammunition. It is the first step in planning and the final determination in execution."[11] World War II campaign studies show that where many commanders ignored weather in their planning, they were unable to achieve their objective because of unanticipated weather.[12]

Forecast for Overlord

The most widely known effect of weather in World War II was during the Normandy Invasion. The forecast made for D-Day is probably the most famous weather forecast of all time. In May 1944, there had been eighteen days on which the weather favored an invasion, but the Germans recognized that the Allies had not taken advantage of them.[13] The events that culminated in the Normandy Invasion show the importance of climatology and forecasting to successful planning.[14]

General Eisenhower initiated a study to see when the invasion requirements for the moon, tide, and weather would be most favorable. During May, the odds were 24 to 1 against, June 13 to 1 against, and July 33 to 1.[15] Moonlight was required for the airborne invasion, the tides for the landing, and the cloudless sky for air support. With roughly equal forces the invasion was only feasible because of Allied air superiority.[16] The plan, though never used, was laid for May originally with the best month to follow.[17] In such a complex situation

long range forecasting of three to five days was very important. Colonel Irving P. Krick backed by General Arnold, Deputy Chief of Staff of the U.S. Army Air Force (USAAF) was responsible for the long range techniques employed by the USAAF staff. Although the British had little experience with long range forecasting, a joint staff was formed and J. M. Stagg was brought into the British military to act as chief meteorologist to SHAEF headquarters. He used a joint telephone conference technique and melded input from the USAAF, British Admiralty and British Meteorological office into the offical forecast.

Using this technique Stagg briefed General Eisenhower and his staff on overcast skies with cloud bases down to 500 feet for June 5th, the first available date in the month. Although the Americans were much more optimistic, the forecast for June 5, 1944 held and justified the delay. The clouds that did occur would have eliminated the air support and strong winds would have disrupted the landing.[18] Krick and the USAAF team remained optimistic for favorable conditions on June 6th. The next low pressure system in the Atlantic was expanding and slowing after the cold front of June 5th passed; they forecast that there would be a 36 hour period of favorable conditions.

At a 9:30 p.m. meeting on June 4th, Stagg annnounced the forecast and Eisenhower made his decision to go. It was a real paradox that Operation Overlord had been postponed when the weather overhead was clear and calm, and the decision made to go ahead with the invasion in a gale of wind and rain.[19] During those critical days preceeding the invasion, the weather forecast had become an obsession of the SHAEF leaders. It was the one thing which no one could plan for sure, and it could not be controlled. If the invasion had to be called off and

delayed until late in the month, the still undetected mobilization would have been picked up by German intelligence. A delay would have also ruined the morale of the troops.[20] In his own words Eisenhower described the scene.

> It was a tense period made even worse by the fact that the one thing that could give us this disasterous set back was entirely outside our control. Some soldier once said, 'The weather is always neutral.' Nothing could be more untrue. Bad weather is obviously the enemy of the side that wants to launch projects requiring good weather, or the side possessing the greatest assests such as strong air forces which depend on good weather for effective operations. If really bad weather should endure permanently, the Nazis would need nothing else to defend the Normandy Coast.[21]

The bad weather on June 5th was a major factor in the element of surprise on June 6th. German naval patrols over the English Channel had been cancelled and the Luftwaffe grounded. German forecasters deprived of key observations from Allied ships stationed in the Atlantic had not picked up the break in the weather. The weather thus provided a better cover for the invasion than anything man could devise.[22]

Rommel, who wanted to move reinforcements into Normandy, had left his headquarters forty miles northeast of Paris to return to Berchtesgaden to plead for his request while low clouds and wind made an Allied invasion seem impossible for the next few days but also grounded air reconnaissance. Post war German assessments cite better weather data as the key to Eisenhower successful decision.[23]

In retrospect, had the invasion been postponed until the next time moon and tide conditions were favorable from June 17th to the 21st, it would have encountered the hurricane force winds of the worst storm in the English Channel in twenty years.[24] It did, in fact, delay Allied resupply efforts and consequently the end of the war; but not as much as it would have if the June 6th date had been pushed up. It would have

been the next year before the Allies could have made the invasion.

The Battle of the Bulge

After the breakout of the Allies from Normandy the fatal decision by Hitler to launch a counterattack into the Ardennes was predicated on weather. Perhaps it was even worse than Hitler wanted. Recovering from injuries suffered from a bomb blast in an assassination attempt, Hitler devised his counter offensive against the thinly spread 12th Army Group of LTG Omar Bradley. The 12th was suffering from the failure of logistics to keep up with the Army. It was here that Hitler decided to attack. Of the five factors that Hitler specified as prerequisites to ensure success, one was for a period of bad weather extending at least ten days to keep Allied Air Forces grounded during the initial phases of the operation.[25]

The German weather service ensured Hitler that such a period of weather would exist in December. On the 14th of that month the forecast was given that specified the 16th as the start of the promised period of bad weather.[26] It was to last for a week. Hitler's goal was to fully exploit the element of surprise and to achieve a rapid breakthrough while the Allied Air Forces were grounded. Some Allied sorties were flown on the 16th but could only interdict deep supply lines. Allied Air forces were grounded until December 23rd when 4000 Allied aircraft were launched for close air support and interdiction against German supply routes.[27]

The bad weather prevented Hitler from bringing up the 200 fighter bombers he had available. It also ruined an airborne operation. High winds and turbulence decimated a paratrooper drop designed to cut off Allied reinforcements, on the first night of the attack.[28] Later, fog played an important part covering the attack of German Panzers early in

the battle but covered American counterattacks later. Plunging temperatures also allowed the American's to retreat with their 30 ton Sherman tanks over frozen muddy terrain that would have been otherwise impassable. The severe winter weather took its toll even on crack units. Six days of battle in some of the coldest temperatures in 30 years badly depleted the American fighting force with frostbite. A final German attack on Bastogne on January 3, 1945 was made in appaling weather with zero degrees Farenheit temperatures, deep snow, and driving snow and fog occurring. Weather had countless impacts on strategy and tactics during the Battle of the Bulge.

These lessons and countless others establish the critical nature of weather on an Army. How the U.S. Army prepares to use weather now will be critical, if another war should occur, just as it has historically.

CHAPTER II

ARMY - AIR FORCE INTERACTION

Inherent Problems in Interservice Support

Parochialism enters into any support agreement between two different services. Perhaps this is the greatest obstacle for the U.S. Air Force (USAF) to successfully meet the growing U.S. Army (USA) need for weather support. The USAF by direction of the Joint Chiefs of Staff (JCS) provides weather support to the USA. Peacetime support in the garrison is quite different from tactical wartime support in the field.[1] Historically, in a war, previously forgotten weather requirements suddenly reappear. During the Vietnam War in 1968, the USAF Air Weather Service (AWS) manpower reached over 11,800 while in 1982 AWS authorized strength is down to less than 4800, but with less than 4000 assigned.[2] Lack of authorized strength has to impact on the willingness of AWS to provide additional support without increased authorizatons. Clear statement of Army support requirement should justify increased AWS manning and increased service and support to the Army.

General unfamiliarity with the opposite service on both sides - the traditions, doctrine, and terminology - make this interaction hard to accomplish. Up to this point neither side had done much to consciously break down the barriers to successful support. For the Army, except for field artillery and aviation, weather has been largely ignored since

Vietnam. Real weather on a day to day basis is not dealt with in the same way that it must be faced in war. Only in war have the AWS forecasters and observers left the comfort of the garrison or the airfield to go to the field with the Army, to live like the Army, and to fully support the Army. At the height of the Vietnam War, in 1968, the AWS Chief of Staff said,

> The most important lesson AWS learned from the Vietnam conflict is that in order to properly support the USA ground operations in combat, a weather support unit must be in being, fully trained, and capable of being deployed with the Army tactical unit when it deploys.[3]

The evolution to action was slow but by mid-1975, the Commander of AWS, BG Barry W. Rowe stated that tactical weather support to the Army could no longer be separated from the Air Force, its organizaton and operations, and that AWS must give equal and due emphasis to Army support.[4]

Even today to an outside observer it appears that the best minds in AWS appear to be channelled toward solving Air Force problems. Yet by the end of 1981, 19% of the total AWS strength (about 700 people) was directly involved with supporting the Army.[5] The AWS has some problems of its own with perception of the quality of life in supporting the Army. Life on an Army post, compared to an AFB, does not attract USAF people. Those who do spend a career in Army support are out of the mainstream to the AWS staff and no matter how well they do in supporting the Army their Officer Effectiveness Reports (OERS) are still written by an AWS Officer who probably works in support of an Air Force flying unit. That is the main reason that 5th Weather Squadron needs to be elevated to the status of a wing where it can coordinate the Army needs for weather support. In general though, AWS Officers tend to circulate back and forth from Army to Air Force support rather than spending a whole career supporting the Army. As a regular process AWS Officers

become detachment commanders (DETCOS) and begin to loose contact with forecasting on a full time basis as a Captain or Major. He is then moved to a higher staff position and by the time he is a Lt. Colonel, he is further removed from practical forecasting. Yet the SWO on a Corps staff need to be a Lt. Colonel and at the same time have real expertise in forecasting. This is certainly a dilemma that also needs to be faced. Perhaps, the only place where daily forecasting expertise is held at the Ø5 level is in the Air National Guard Weather Flights where the SWO happens to be a practicing meteorologist in civilian life.

Today when a new SWO comes to Army support for the first time he has had no formal school about how the Army operates. AWS Pamphlet 5Ø-6, Army Staff Weather Officer Guide encourages the SWO to take the initiative, to break into the Army structure, to find out what the Army unit does, to find out what their needs are, to interpret those needs in terms of weather for them, and to make believers out of the G2 and the G3 by showing them what he can provide and how they can use it.[6] This kind of wording and further statements about vigorously pursuing any chance to be included in staff activities that will enable him to have his basic support in equipment, logistics, and communications certainly indicates that he will be slipping into something less than a smoothly running support arrangement. The SWO probably arrives with the experience of the traditional Air Force where a 24 hour forecaster fills all their needs. However, this and other standard Air Force products don't fit the G2 and G3 needs for very accurate forecast out to 48 and 72 hours.

Even with the many problems new joint doctrine is in fact starting to emerge to support the concept of the AirLand Battle. A new school

for the SWO is being designed by TRADOC. New initiatives for liaison officers and SWOs at more levels will be made when the stated Army requirements authorize more spaces for AWS. However, it may take a long time to turn around attitudes developed long before Force Modernization increased the Army's need for weather support.

Importance of Weather to Planning

In a wartime scenario weather will play a dominate role in choice of strategy and tactics by the battlefield commander.[7] In order to make good decisions that leader needs accurate forecasts for the times he needs and in the terms he understands in order to make that information a viable ground combat multiplier.[8] In tactical planning however, mission analysis, enemy situation and terrain are domianat considerations.[9] Yet, forces available, time of day, and weather play key roles depending on the situation. In a more static Army situation, unlike the Air Force planning problems, there are no alternate targets, and the enemy situation dominates the planning process. The mutually supporting nature of mission of commanders at battalion (BN) and below limits the flexibility at those levels to react to the influence of weather.[10]

It is at the corps and division level where the weather forecast must make its impact on the G2 and G3. The SWO must identify the parameters that are forecast to occur within the area of interest that will impact on observation and fire, concealment and cover, or avenues of approach.[11] The G2 must employ a system that can handle a larger area, a longer time, and more airspace as the manueverability of Army tactical units becomes greater.

The impact of weather on Combat Support (CS) and Combat Service Support (CSS) units must also be taken into account. Channels for

weather forecasts to flow on a regular basis to the logistical tail of the Army are equally important. History has shown that degradation by the extremes of weather of the ability to rearm, refuel, and rebuild can have as much impact on the ability to fight as what happens on the battlefield itself. The new worth of accurate forecasts is extremely variable. But when the weather is severe, it suddenly becomes critical in a wartime scenario.

CHAPTER III

ARMY SUPPORT FOR WEATHER

Requirements

Joint Army/Air Force Regulation AR 115-10/AFR 105-3, 1 October 1981 outlines the weather support responsiblilities. Much of the support is provided by the Army itself. The support to Artillery and to Research and Development agencies is provided by the Army. In all, 885 people in weather support come from the Army.[1] That is more than the 700 that come from the Air Force. Army support in the Research, Development, Testing, and Evaluation (RDT&E) phase of weapons acquisition is a critical point where thorough evaluation of all weather parameters are needed but are overlooked in key areas. AR 70-38, Research, Development, Test and Evaluation (RDT&E) of Material for Extreme Climatic Conditions, is written to insure that new equipment and weapons systems will perform adequately under environmental conditions likely to be found in the areas of its intended use. It does point out that clouds, rain, falling snow, ice, fog, blowing sand and dust, smoke and haze all affect the performance of electro-optical (E-O) systems because of attenuation and degraduation of electromagnetic radiation in the atmosphere.[2] AR 70-38 does not mandate testing of new systems for visibility because it states that the effect of these environmental factors on the operation of E-O devices cannot be reliably quantified at this time.[3] Therefore, design

criteria for visibility requirements are not given in AR 70-38. With 200 people supporting weather at the Atmospheric Science Laboratory, Fort Huachuca, AZ, it would certainly seem within the current state of the art to test for visibility. Every AFB has a transmissometer that measures visibility down to the meter. It would seem that by changing wavelength, a similar device could measure visibility in whatever range required for each laser, thermal sight, or E-O system. Several laboratories are looking at the Battlefield obscuration problem independently, but no one is coordinating all these efforts or doing the RDT&E testing of the actual weapons systems in the fog, snow, haze, and drizzle in which they will have to operate. Program managers (PMs) don't like to have their systems tested in bad weather because they would make them look bad. With men's lives and outcomes of battles in the balance it is hard to believe that PMs don't demand realistic environmental testing for their systems. Perhaps the temptation to use the system as a stepping stone for promotion is just too great. It certainly points to a definite breakdown in the system. PMs need to have the technical training first before they take on a system in order to be able to understand what tests need to be made. Then they need the courage to demand the test be made regardless of time deadlines.

Another area that Army is required to support by AR 115-10 is Field Artillery. There are three MOSs in Artillery Meteorology (Arty Met) but they are observers and repairmen not forecasters.[4] For direct artillery fires visibility is the most significant effect while winds affect indirect fire accuracy and probability of first round kills.[5] As the range increases from 5 to 18 km. the average weather induced error increases from 17 to 45%. In many scenarios, weather parameters are the

largest contributor to total system error.[6] Today the Arty Met sections still use the AN/GMD-1, Rawinsonde set, a World War II vintage piece of equipment with no direct interface with the Tactical Fire Direction System (TACFIRE). Originally the GMD-1 was to be replaced by an entirely new Field Artillery Meteorological System (FAMAS) that would interface with TACFIRE.[7] The system has not been fielded yet and the now bigger, heavier, and more expensive system is called the Meteorological Distribution System (MDS). It is scheduled into the inventory in FY 83. This is a critical piece of equipment which will interface with TACFIRE to provide a much needed capability to use current information not old data.

AR 115-10, (para 1-18), specifies that the Army is responsible for surface and upper air observations and computation in support of Nuclear, Biological, and Chemical (NBC) operations and for similiar observation in areas forward of the division command elements. To fill that need the Forward Area Limited Observation Program (FALOP) was initiated but the observations were unsatisfactory for AWS use and often unobtainable. Reforger 77 showed that getting FALOP reports back through the communications net was difficult if not impossible.[8]

Communications

Communications have always been the biggest problem in weather support. Forecasters need alot of data, and mobile systems often break down. As far back as the Korea War in the 1952 Siple Report, the inability to get weather information to the front line of Army elements was the major deficiency which detracted from providing adequate weather support.[9] Today AR 115-10 (para 2-1) lays out the Army's tactical communication responsibilities (See Figure 3-1). In the tactical situa-

JTF/USAF/ARMY
TACTICAL WEATHER SUPPORT SYSTEM

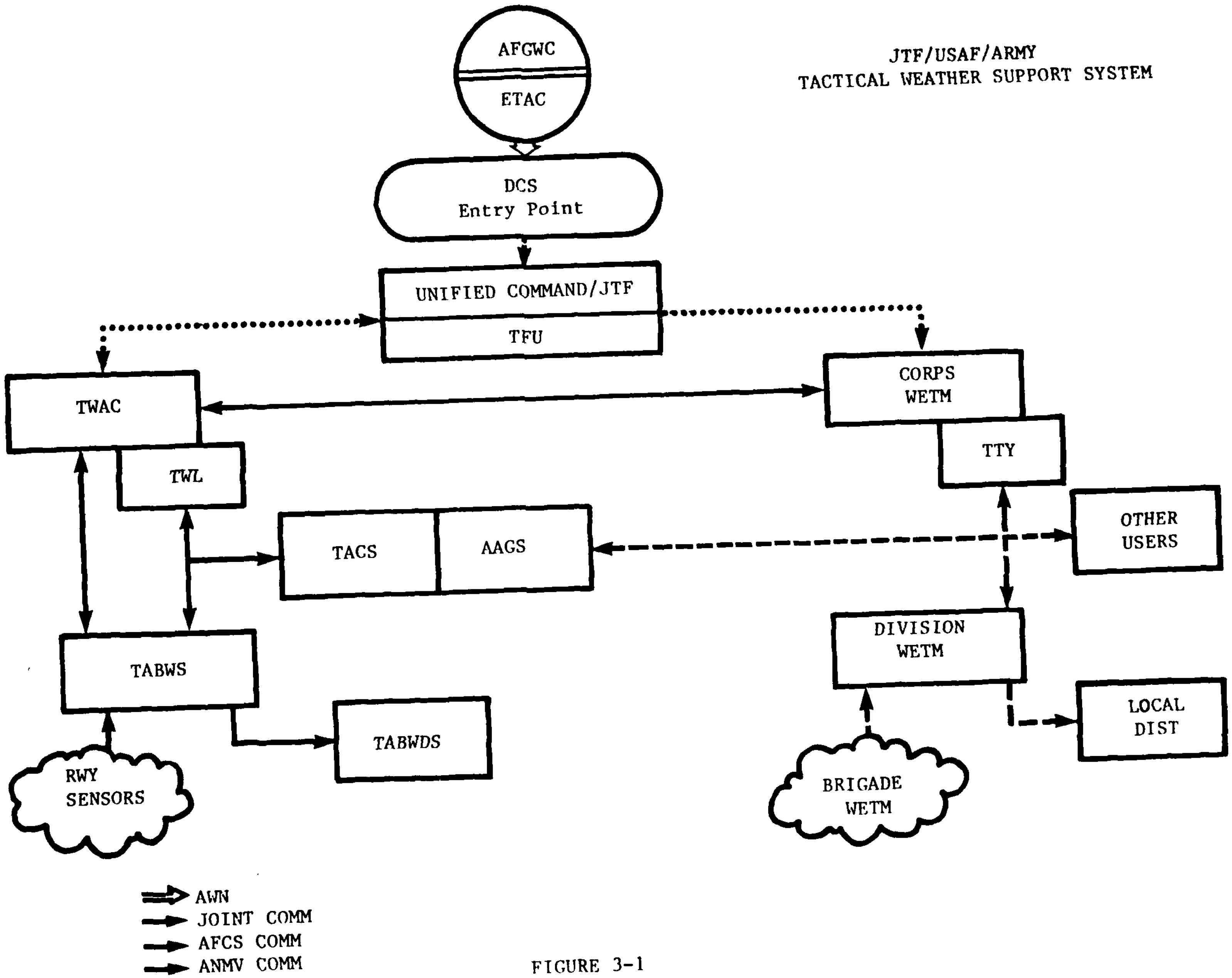
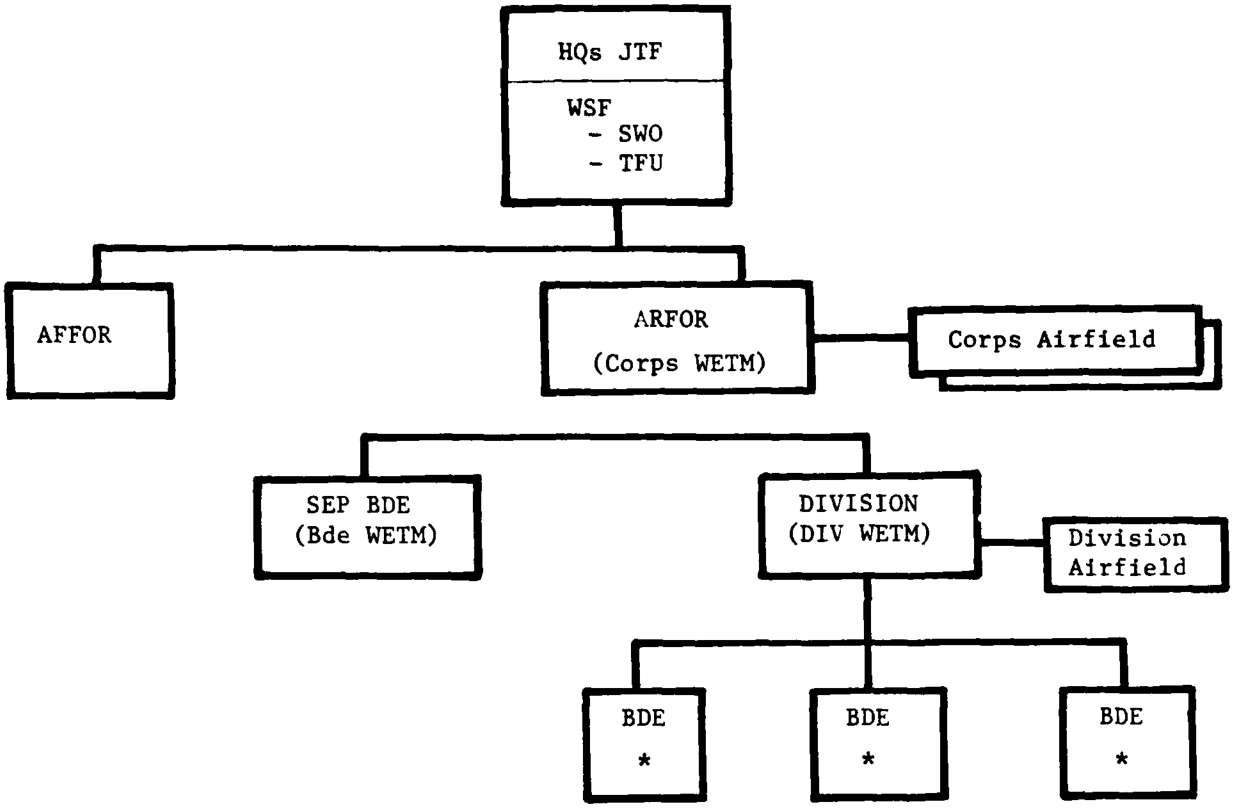


FIGURE 3-1

tion the Air Force is responsible for weather circuits down to the Defense Communication Service (DCS) interface point between non-tactical and tactical communications. From there on down it is the Army responsiblity. The AWS operates the weather equipment provided to them by the Army and authorized in the TOE/MTOE. During the mid-1970's studies showed the key drawback to successful weather support was communications. Today, it remains the biggest tactical problem in the field. To solve the problems the Army must supply dedicated, reliable communications and modern weather communication equipment that is high speed and compatible with incoming signals.

Figure 3-2 shows the flow of weather data down to division level. The path from Air Force Global Weather Center (AFGWC) to the DCS entry point at the Joint Task Force (JTF)/Tactical Force Unit (TFU) is by satellite link via the Automated Weather Network (AWN). The system depends on satellite communications to get to the theater. Former Defense Secretary Harold Brown credited the Soviets with weapons in the late 1970's that might knock out low flying spy satellites but not synchronous communications satellites up at 22,300 miles.[10] But it was just recently that Under Secretary of Defense for Research and Engineering, Richard DeLauer in secret testimony, subsequently read into the Congressonal record by a Congressman, reported that as soon as 1983-1988 U.S. geosynchronous satellites for communications and surveillance would be threatened by Soviet space based lasers.[11] Such a threat has serious implications for any kind of overseas weather support. Not only do all communications travel by satellite but the satellite pictures from the Defense Meteorological Satellite Program (DMSP) provide the most comprehensive overall look at the weather in any theater of operations. One 7th Air Force commander in Southeast Asia called the DMSP products "the

HYPOTHETICAL WEATHER SUPPORT FORCE (WSF)
TO A JOINT TASK FORCE



LEGEND

WSF - Weather Support Force
TFU - Tactical Forecast Unit
 * - Brigade observing team

NOTE 1: Unconventional Warfare Elements can be added.
NOTE 2: Multiple divisions and separate brigades not shown.
NOTE 3: Optional separate brigade airfield not shown.

FIGURE 3-2

greatest innovation of the war," during a national television show in 1967.[12] If our basic lines of communication and the DMSP are in fact vulnerable, or just the receivers on the ground vulnerable, then we must make backup arrangements with redundant systems for communication and sources of weather data within the theater. Can the USAF support US Army weather requirements without the satellites? Such a contingency needs to be addressed.

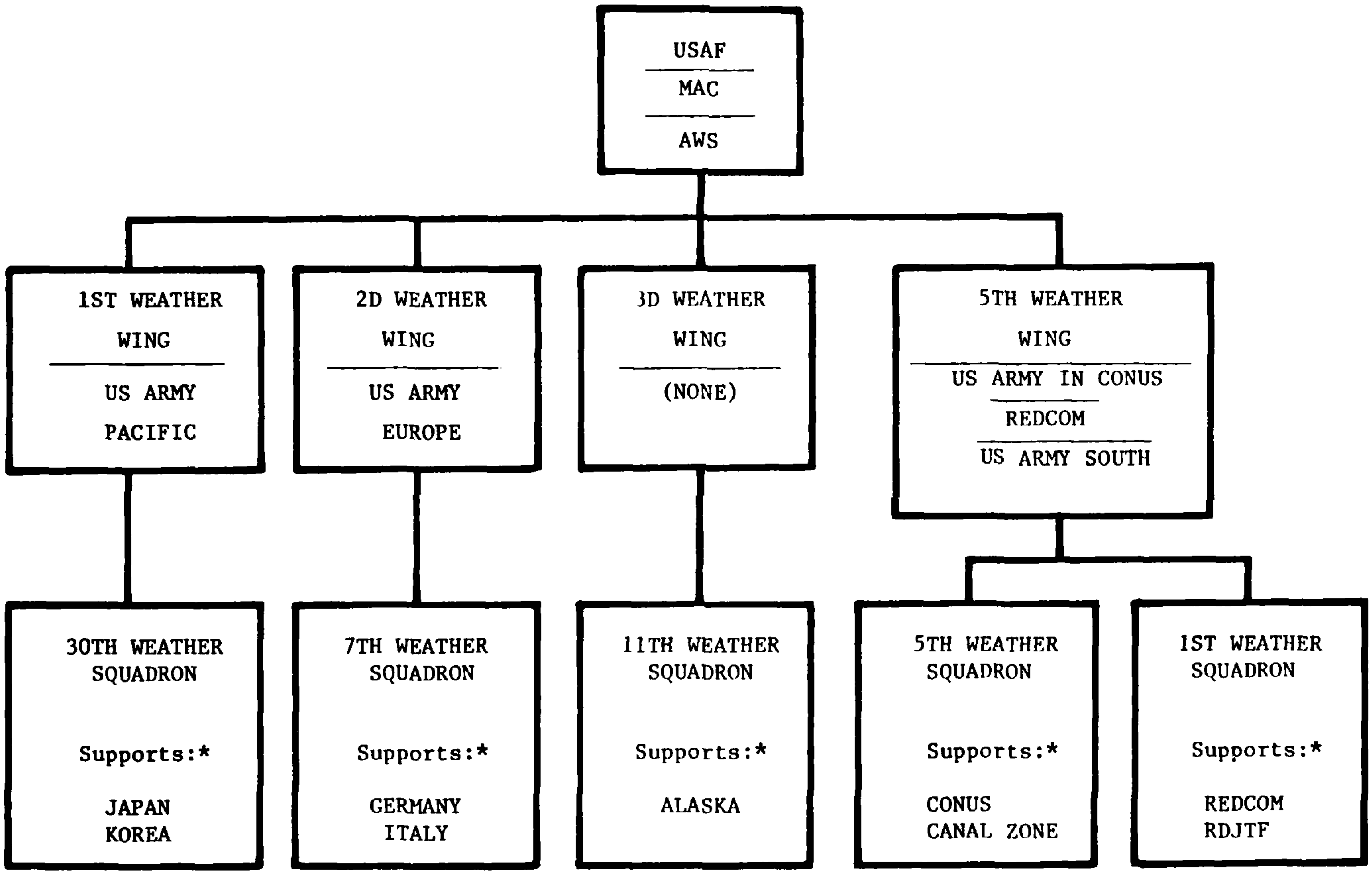
CHAPTER IV

AIR FORCE WEATHER SUPPORT

Concept

The weather support to fixed Army garrisons and MACOMS, to Army engineers to support trafficability, riverstage and floodstage forecasting, and to tactical Army units is provided by the Air Weather Service (AWS) through four different Weather Wings. First Weather Wing (1WW) supports U.S. Army Europe (USAREUR), Fifth Weather Wing (5WW) supports the Training and Doctrine Command (TRADOC), Forces Command (FORSCOM) units, and Readiness Command (REDCOM). All USAF Tactical Air Command (TAC) Air Force Bases (AFB) are also supported by 5WW which supports the Army in the CONUS. Under 5WW the 5th Weather Squadron (5WS) supports most of the combat arms units in the CONUS. The rest of the organization is shown on Figure 4-1.

Garrison weather stations support Army aviation elements. Weather stations are at all division headquarters, at the aviation training center, and at a number of independent aviation elements. There are 31 detachments and 30 smaller operating locations. Over half of these are in Korea and Europe. Each corps, division, armored cavalry regiment, and separate brigade is supported by a weather team (WETM) commanded by the Staff Weather Officer (SWO) who is a member of the commanders special staff under the supervision of the Assistant Chief of Staff for Intelligence, G2. The SWO normally operates in the Collection,



Supports:* Provides or arranges for weather support to Army units in the countries that follow.

Current Army Weather Support Structure

FIGURE 4-1

Management, and Dissemination (CM&D) section of the Tactical Operations Center (TOC). Field Manual 34-10, Military Intelligence Battalion, refers to the WETM as the USAF Weather Section which consists of the SWO, DTOC forecast element, and weather observing team. A corps is supported by a 17 man team including forecasting to corps airfields. A division is supported by a 16 man team. Each Armored Cavalry Regiment (ACR) and separate brigade is supported by a seven man team. Support is provided to special forces with jump qualified personnel stationed at Fort Bragg and Bad Toelz.[1] Support is provided to the Army Reserve Components (RC) by the Air Naional Guard Weather Flights in a similiar fashion.

The Role of the SWO

The SWO, as commander of the WETM, has AF command channels that parallel Army channels. The SWO may have a large WETM or operate alone as at the Combined Arms Center (CAC), Fort Leavenworth, KS. Although there appears to be a need for more SWO support at MACOMS and agencies where the design of equipment and the doctrine for the Army is developed, I have only tried to describe briefly the general role of the SWO in tactical support in the field. Although the current FM 31-3, Weather Support for the Army, is out of date, the new joint TRADOC 525 series/MAC pamphlet has not been issued. Since 1969, there have been four revisions but never any final agreement between the Army and AWS on requirements and results. With the issuance of AR 115-10/AFR 105-3 in 1981 and this pamphlet, as well as the Army's clear statement of what its requirements are, hopefully joint concepts will be agreed on and new guidance issued.[2]

In the past Army commanders and staffs have not wanted the SWO to

tell them what they could do or could not do because of bad weather, but would rather have a probability forecast to input with other factors into overall planning.[3] The new joint doctrine will provide such a facility for the SWO through the Intelligence Preparation of the Battlefield (IPB). In the field the SWO operates with the military intelligence unit (Combat Electronic Warfare and Intelligence (CEWI)). His WETM or DTOC forecast element supports him on the staff with forecasts using information obtained via teletype equipment, dedicated High Frequency (HF) Radio Teletype (RATT) channels operated and supplied by the CEWI battalion.[4]

Along with the Army terrain analyst the SWO provides tailored input to the IPB system through probability forecasting and Weather Impact Indicators (WII)s. These probability forecasts should be able to aid decision makers in selecting weapon systems.[5] This is an emerging cabability that is programmed to become automated along with the IPB analysis.

The IPB concept is that before the SWO goes to the field he will have already input the climatology for the operations plans. The SWO must know the mission, tailor the field support to meet the operational needs, and maintain a close liaison with the special staff and other agencies. He must coordinate with other Army units to ensure his WETM receives all logistic support needed for his men and equipment.[7] He is really the linchpin connecting weather support to tactical operations.

The IPB System

IPB is an analytical process integrating intelligence, topography, and weather. Five steps, using templates now and video displays in the future, include threat evaluation, determination and evaluation of the

areas of interest and influence, terrain analysis, weather analysis, and final integration of all intelligence. In a situation where the Army will be outnumbered it becomes even more important that terrain and weather be correctly evaluated.[8] IPB should provide the process.

In order to input the right values to IPB, critical values must be established for weapons systems and forecasts made to match them. In 1981, the Army stated its specific requirement and sent them from DA/ACSI to AWS. The challenge now rests with AWS to make forecasts that can be input into IPB that match those values.

The requirement submitted listed all the Army users in Combat Arms, Combat Support, and Combat Service Support. Weather parameter ranged from seeability (some unknown measure of visibility apparently in wave lengths outside visible light) through all weather parameters to electromagnetic propagation. The need for critical values, preferred format, spatial resolution, required accuracy, frequency of forecast or observation are clearly stated.[9] The 1982 requirements are now being updated by the Army users. AWS now must state what it can and cannot do. The AWS has been oriented to garrison and aviation support which is much like support to an AFB. In the field longer lead times required by corps out to 72 hours, visibility at specific wave lengths for E-O systems, water content for rotoblade icing, exact amounts of rainfall for trafficability forecast all present areas in which AWS does not have alot of expertise, and will require concentrated effort from AWS to meet those needs.

CHAPTER V

FORCE MODERNIZATION

Electro-Optical Concepts

Force Modernization has played a significant role in the evolution of Army doctrine to the highly manuever oriented AirLand Battle concepts of today. Electro-optical (E-O) systems have significantly improved the Army's capabilities and in a very short span of time developed to the point where they will dominate the battlefield in the near future. The Five Year Defense Plan (FYDP) shows the extensive plans to buy more and more of these systems and munitions. The high kill capability of these systems must not push the Army into replacing conventional weapons with Precision Guided Munitions (PGMs) on a direct exchange basis because PGMS will not be able to be employed in many situations.

The effectiveness of PGM, terminally guided munitions, and thermal imaging devices are dependent on the environmental conditions; weather forecasting has got to increase in importance with each new system.[1] Traditional weather forecasts are no longer sufficient to aid the decision maker who must employ these systems. PGMs are affected by rain, clouds, atmospheric aerosols, and solar illumination.[2] "One of the most sensitive decisions facing operational commanders today is the selection of the optimum weapon system to be used. Such a decision cannot be made

without component weather advice."[3] These words of Admiral Moorer apply equally well to the battlefield as they do to sea warfare.

In order to address the degradation of a few key weapons systems by weather the operation of E-O systems must be understood. The performance of E-O systems depends on three factors: electro-optical characteristics of the targets and backgrounds on the battlefield; the atmosphere between these targets, the background, and the E-O system; and the sensitivity of the E-O system. Weather conditions affect the first two factors both directly and indirectly.[4] Each E-O system has a sensor and a tracker. The sensor scans for an energy contrast but has a threshold value below which it will not detect the target. The tracker locks onto the target and steers the aerodynamic control surfaces on the weapon to the target. The guidance system can act in three different ways. It can be an active system in which it senses reflected energy off the target that the system generated itself. It can be semiactive in which it senses energy from a laser designator located elsewhere. Or it can be passive in which it homes in on the natural contrast between the target and the background.[5]

Most E-O systems operate in the visible light range or the infrared (IR) portion of the electromagnetic spectrum (see Figure 5-1). In the IR range between 3-5 microns and between 8-14 microns windows exist where IR radiation is attenuated the least by atmospheric conditions.[6] However, the attenuation by water vapor is significant even in these window regions. Fog, drizzle, and clouds do cause problems for IR systems (see Figure 5-2). Rain with large but relatively sparse spacing in the air does not cause as severe a problem,[7] but may indeed cool the background and the target to nearly the same temperature where a passive

OBSCURANT/E-O DEVICE RELATIONSHIP

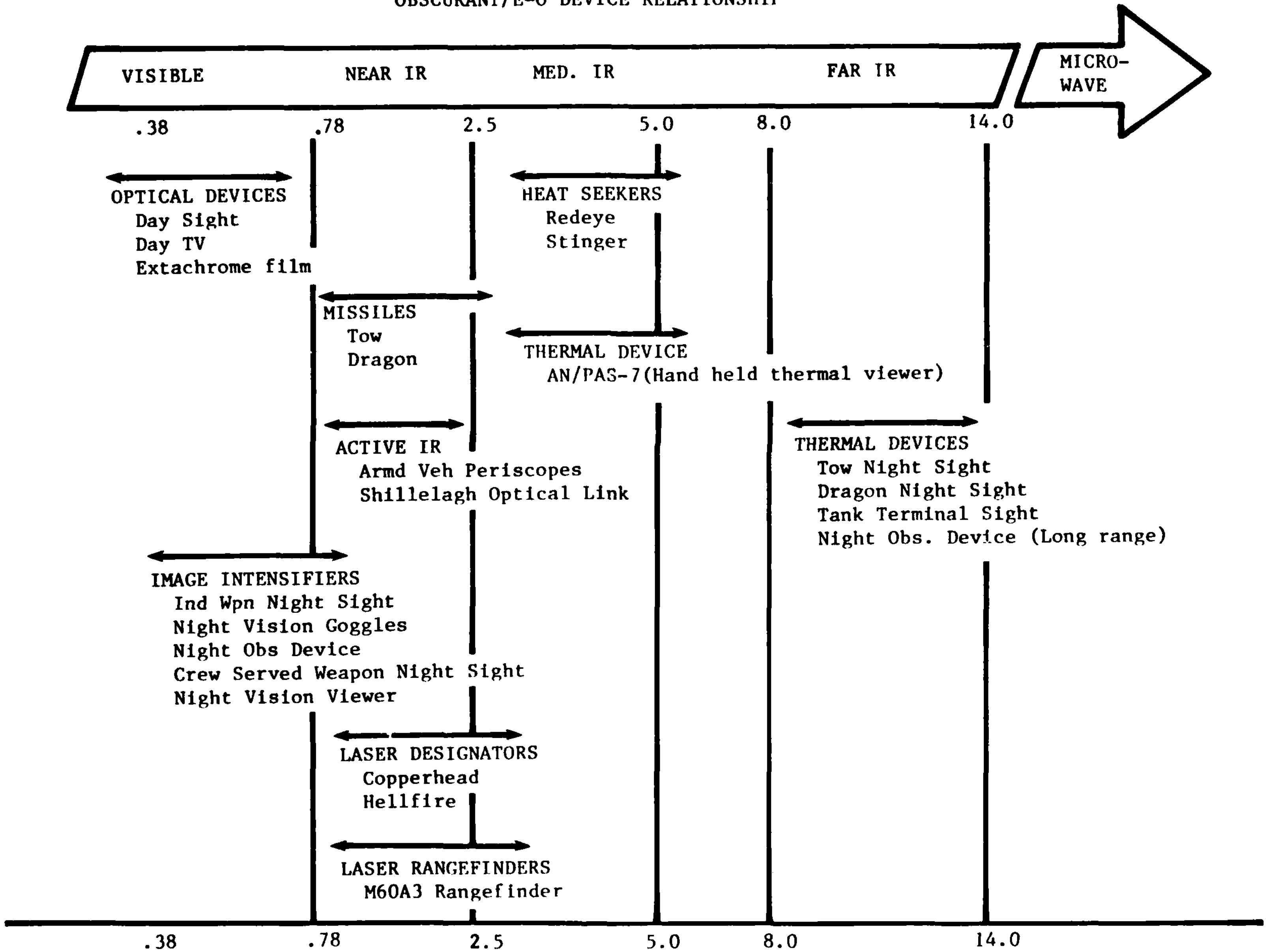


FIGURE 5-1

PRIMARY PROPAGATION SENSITIVITIES

SYSTEM	CLOUDS, FOG & MOIST HAZE	WATER VAPOR	PRECIPITATION	DUST AND DRY HAZE
VISIBLE	X		X	X
INFRARED	X	X	X	
LASER (NEAR IR)	X		X	X
LASER (FAR IR)	X	X	X	
MILLIMETER			X	
MICROWAVE			X	

Weather Affects on E-O Devices

FIGURE 5-2

E-O system will not function. Even a change in relative humidity will have some effect on the transmittance of IR radiation. IR does have a distinct advantage over the eye in haze that ranges from 10 to 100 times greater for target acquisition capability.

As the wavelength gets longer going from visible radiation to IR the resolution or accuracy in seeing becomes less. Increasing the wavelength further to millimeter wave (MMW) and microwave requires larger antennae which enlarge the equipment, make the resolution less, but make the penetration of an obscuration in the air easier. Radar can penetrate the weather but battlefield targets are often not radar identifiable because of the resolution.[8] Consequently, the design of an E-O system is always a trade off between weapon resolution and environmental sensitivity. The climatological data for an area where an E-O system is planned to be employed must be considered before it is designed.[9]

The AirLand Battle in a NATO Environment

Climatology in the NATO scenario is very significant when considering E-O systems. The weather in northern and central Europe is so bad during the winter months that it should be considered part of the threat. Cloud bases are below 100 feet and visibility less than 5 km. on one day out of three winter days on the north German plain. In the northern flank over the highlands the same conditions exist on one day out of every two.[10] To put it into flying terms with only seven to eight hours of daylight on an average January day, weather reduces flying to only a 4.5 hour average and two sorties per day possible. This is significant to the Army who will depend on the Air Force to strike the second echelon until Army long range delivery systems are developed. Air Force systems like the TV guided Maverick missile need a

cloud free line of sight (CFLOS) and most tactical Air Command fighter-bombers need much more than 100 foot ceilings in order to fly and deliver weapons. There is no "all weather" Air Force. The A-10 is famous for its icing problems. European winter weather is perfect for producing ice on the A-10 and helicopters. When the IR version of the Maverick become available in the near future it will give the A-10 a night time capability.[11] Even a proposed two seat version of the A-10 equipped for night/adverse weather using advanced radar with a moving target indicator (MTI), forward looking infrared (FLIR) or low light television (LLTV) doesn't work in fog, and can be unreliable in temperature inversions. These are the same type of systems designed for the Advantage Attack Helicopter (AAH). In the European climate it could fail the pilot when he needs it most.[12] The F-111 will carry deep battlefield air interdiction (BAI) to the enemy by flying very low using its terrain following radar (TFR). The TFR does not work over ground covered by a thick layer of soft fluffy snow. In the summer the TFR sees a rainstorm as a mountain in some cases and tries to climb over it. The Vietnam experience has documented these cases well. The ground commander must consider these and similiar impacts on Air Force delivery systems because they will have direct bearing on his overall plans and the progress of the second echelon threat.

Even though FM 100-5 points out that U.S. NATO forces will have visibilities less than one km during fall and winter months on one out of three mornings, a 1979 Institute for Defense Analysis study showed that key officers at all Army schools, centers, and in the field thought that overall combat systems were sufficiently weather adaptable that weather forecasts characteristically were not a consideration.[13] That line of thinking apparently continues with younger officers because a

survey at the U.S. Army Command and General Staff College in 1980 indicated that battalion commanders tend to disregard the weather information that they do receive.[14]

When looking at the weather affects on NATO operations, one must consider the importance of the Soviet philosophy of uninterrupted day and night continuous battle as emphasized by A. A. Sidorenko in The Offensive. In this regard NATO commanders have made weather a greater consideration than our commanders in the recent past. Former Chief of Staff of the West German Air Force, General Johannes Steinhoff evaluated it thus,

> If the Russians come, they are unlikely to court suicide by choosing a bright summer day with visibility to the horizon; they will come at night, exploiting the murkiest weather that their forcecasters can predict, and they will travel beneath a sophisticated and dense antiaircraft umbrella.[15]

The Soviets train in the extremes of weather and are not nearly as dependent on air power as we are to fight the second echelon battle. Weather has proven to be a historical ally to the Soviet offensive. The Soviets have a much better sense of history than we do.

Impact of Weather on Modern Weapons

The Tube Launched, Optically Tracked, Wire Guided (TOW) antitank missile system will play a key role in defense against a numerical superior tank force. Target acquisition is the key to the TOW as it is to all PGMs. In a TOW a modulated IR source in the tail of the launched missile is followed by the optical sensor on the launcher which thus commands the missile along its path to the target some 3000 meters and 15 seconds away.[16] The range at which a moving tank can be detected varies directly with horizontal visibility. During the worst month in the NATO scenario the visibility is only 1000 to 2000 meters one fourth

of the time.[17] Slant range visibility from a helicopter will be even worse. All this must be considered days ahead when tactics are planned.

Laser target designators (LTDs) work in the visible light range or just outside it and will be affected by obscurations and restrictions to visibility. All semi-active E-O systems depend on a target spot from a forward observer (FO) on the ground, mounted, or in the air. The reflectivity of the target can be reduced by natural phenomenon such as mud covered or wet tanks or by special absorbant paint. Light snow, fog, or clouds break up and spread out the concentrated beam, making it into more of a spot light. Dr. S. Gerrard at U.S. Army Material Development and Readiness Command's (DARCOM) Hanover, New Hampshire Cold River Research and Engineering Laboratory (CRREL) has shown such results in a study called "SNOW I."[18]

LTDs will be used to mark targets for several new systems entering the Army inventory. Copperhead is a terminally guided, 30 km range, munition fired from a 155 mm howitzer which searches for the reflection of the laser beam projected onto the target by a FO. Division interdictions capabilities will ride partially on its capabilities. The G2 and G3 need a forecast far enough ahead of time to be able to evaluate the limitation of weather on it and the plans and operations.

The UH-64, AAH will use the helicopter launched fire and forget (HELLFIRE) missile as its primary weapon system when it comes into the inventory. It will be initially fielded for use only with a LTD on the ground or that it carries itself. It will later be armed with an autonomous mode using a lock on before or after launch option. In this mode the pilot will be able to hide behind terrain, fire, and then activate an autopilot sequence which locks on after it clears the ter-

rain.[19] However, HELLFIRE specifications show that it has a built in climb designed into its trajectory after it is launched. If it locks on, then climbs into a cloud it has no capacity to go back on to it seeker mode to find the target and lock on a second time. It will just follow the ballistic path and miss the target. Again plans employing HELLFIRE will have to consider this and the low NATO ceilings.

Passive systems using the IR or MMW ranges can be affected by weather more than any other because they depend on the natural thermal contrast of the target with the background. Continuous cold rain can cool a tank until it is so close to the temperature of the background that its thermal signature may dissappear. Thick layers of dust over the battlefield can mask the thermal signature of a target so it cannot be detected. In extremely cold weather a tank can become colder than the snow. When a tank is running through snow, the uncovered tank track is warmer than the tank and through a thermal sight produces a "hot snow" phenomenon.[20] The effect of warming at sunrise and cooling at sunset creates two points where a tank will have the same temperature as the background and a "crosssover" phenomenon will occur, and no thermal signature will exist until the contrast is greater than the threshold value of the thermal sight.[21] In talking to officers experienced with the M-1 and M60A3 tanks one officer at the USA War College has said that he has seen this crossover exist for about seven minutes both near sunrise and sunset. Infrared imagery at Fort Polk in February 1977 showed that a tank operating in a wooded area had lower radiative temperature than the surrounding trees.[22] As it turned out, very low precipitation during the previous year caused the effect.

Besides thermal imaging, the M-1 has input for temperture, winds, and barometric pressure. External sensors could provide the temperature

and the winds but not the barometric pressure. If the external sensors are removed because they are easily damaged, then forecast for all three values will be needed down at the tank platoon level. Techniques to obtain approximate winds have been developed along with battlefield tactics for employing smoke, but how will the forecast values be obtained.[23] It is another example where the support has not caught up with the equipment. Timely forecast will be needed for this and other reasons such as the trafficability problems a much heavier 60 ton tank will have with the shearpoint of the frost layer in the ground.

Future systems, in the testing phase now, like the Multiple Launched Rocket System (MLRS) modification III and Assault Breaker will use terminally guided submunition warheads with passive seekers to act in the long range role against self propelled artillery, tank columns, etc. Weather effects must be considered in the design stage using the climatology of the area where they are expected to be used. In clear weather with unlimited visibility PGMs of all types engage targets at maximum range with a very high probability of a single shot kill while still far enough away to protect the delivery system.[24] In the real world weather will restrict these E-O systems. In order for the Army to fight successfully with these systems combat commanders have got to integrate the SWO into the G2 and G3 functions and produce a smoothly running staff able to adjust to weather and able to use forecasts tailored to special Army needs.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATION

Conclusions

I started out to determine if U.S. Air Force weather support to the Army is adequate today and if it will be adequate to support the Division 86 and Army 86 concept with all the new weapons systems brought on by Force Modernizaton. In general today Air Weather Service support is satisfactory for garrison and fixed airfields though lacking SWOs at key MACOMS, centers, and schools. However, in a tactical wartime scenario it will be sadly lacking because of manning, experience, communications, equipment, and lack of a fully implemented system to incorporate weather.

The following are specific conclusions.

1. Joint Army/Air Force Doctrine is finally starting to evolve regarding weather support for the Army. However, there are still many outdated regulations and manuals in Army files that must be updated. Basic field manuals for all Combat Arms need to be much more specific about how weather will impact on specific tactics and give several examples.

2. The Army has not educated its commanders, G2s, and G3s very well about the impact weather will have on them in war. In general it has not given its Combat Arms officers enough training in how weather affects tactical operations.

3. Force Modernization with its many E-O systems has made weather support much more critical for the Army.

4. The Army does not test new E-O systems for the impact of weather parameters on visibility during RDT&E.

5. AWS forecasts do not match the wartime needs of the Army in terms of enough length to the forecast, the critical values forecast, and needed accuracy.

6. The AWS Staff does not place enough emphasis on Army support to provide what the Army really needs in terms of people and products.

7. There are not enough ASW SWOs in teaching, advisory, and liaison rolls at key Army RDT&E facilities, schools, and centers to properly integrate weather into curriculum, doctrine, and tactics. In turn, there is not enough Army Combat Arms liason to the AWS Staff.

8. However, the Army has stated its requirements in clear terms and given them to AWS.

9. The IPB approach may be able to integrate weather into the intelligence evaluation process, but much more work must be done as the system evolves. Probability forecasts and Weather Impact Indicators should help in the process in the future.

10. Communications remains the key tactical problem which degrades weather support.

11. Up until now the new Army SWO has received inadequate indoctrination into Army support and found it hard to fit into the special staff. A new TRADOC course for just this purpose has been written and now just needs to be implemented.

Recommendations

Based upon the factors that I have investigated in this paper I make the following recommendations:

1. The 5th WS should be given wing status to insure that the Army case is represented at the AWS Staff level. This new wing would not be responsible for AWS units beyond those of the 5WS but would serve as a central point to direct and coordinate a united Army effort.

2. In conjuction with my first finding SWOs should be added at all MACOMS, all key schools and centers where they are not already located. This would include the Chemical School and Center and the Intelligence and Security Command.

3. AR 70-38 must be changed to include testing E-O systems for visibility while still in the RDT&E stages.

4. Army research, done in several labs all in different locations and commands, but mostly at the Atmospheric Science Laboratory and in RDT&E, need a central control point at HQDA to coordinate and direct well meaning but unproductive projects.

5. The general knowledge of the impact of weather on Army operations must be improved. The advanced and basic course in Military Intelligence need a section dedicated to weather only, and separate sections on weather impacts on weapons and terrain. A section on weather needs to be taught at each Combat Arms School. All of these courses should be taught by a SWO with prior service experience with the Army in Europe where the impact is the greatest.

6. A section on weather, again taught by experienced SWOs, needs to be taught at USA CGSC and USAWC. These are special courses that have to be developed. When the course for General Officers is

instituted at the War College, weather also needs to be included in that curriculum.

7. TRADOC/AWS need to implement the plans for an Army Indoctrination Course of two weeks for SWOs going to Army support. Air National Guard Weather Flight forecasters should be required to attend also.

8. Greater liaison is needed between the AWS Staff and Combat Arms users. Regularly scheduled trips to the AWS Staff by Army Officers and reciprocal trips to Army training centers and exercises on a regular rotating basis by AWS Staff are necessary to develop a repoire between the two services.

9. More AWS input to Army journals by SWOs who have served with the Army are necessary. They should be on both the level of Military Review and the USAWC Parameters, and the more popular level of Soldier, Armor, and Aviation Digest. SWOs should be required to submit articles. The historical articles of the AWS historian, John Fuller, that previously appeared in Air Force publications should be submitted when they show Army application.

10. A change in attitude is what is needed on both sides. Through a good education effort, based on state Army requirements, both sides can learn that an enlarged AWS support role for the Army is mutually beneficial and vital to the success of Army 86.

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